



# UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.

35.C12076 DIV. I

First Named Inventor or Application Identifier

MASAMINE MAEDA, ET AL.

Express Mail Label No.

Assistant Commissioner for Patents  
Box Patent Application  
Washington, DC 20231

## APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

## ADDRESS TO:

1. ☒ Fee Transmittal Form  
(Submit an original, and a duplicate for fee processing)

2. ☒ Specification Total Pages 33

3. ☒ Drawing(s) (35 USC 113) Total Sheets 14

4. ☒ Oath or Declaration Total Pages 2

a. ☐ Newly executed (original or copy)

b. ☐ Unexecuted for information purposes

c. ☒ Copy from a prior application (37 CFR 1.63(d))  
(for continuation/divisional with Box 17 completed)

[Note Box 5 below]

i. ☐ DELETION OF INVENTOR(S)  
Signed Statement attached deleting inventor(s)  
named in the prior application, see 37 CFR  
1.63(d)(2) and 1.33(b).

5. ☒ Incorporation By Reference (useable if Box 4c is checked)  
The entire disclosure of the prior application, from which a copy of the  
oath or declaration is supplied under Box 4c, is considered as being  
part of the disclosure of the accompanying application and is hereby  
incorporated by reference therein.

6. ☐ Microfiche Computer Program (Appendix)

7. Nucleotide and/or Amino Acid Sequence Submission  
(if applicable, all necessary)

a. ☐ Computer Readable Copy

b. ☐ Paper Copy (identical to computer copy)

c. ☐ Statement verifying identity of above copies

## ACCOMPANYING APPLICATION PARTS

8. ☐ Assignment Papers (cover sheet & document(s))

9. ☐ 37 CFR 3.73(b) Statement (when there is an assignee) ☐ Power of Attorney

10. ☐ English Translation Document (if applicable)

11. ☒ Information Disclosure Statement (IDS)/PTO-1449 ☐ Copies of IDS  
Citations

12. ☒ Preliminary Amendment

13. ☒ Return Receipt Postcard (MPEP 503)  
(Should be specifically itemized)

14. ☐ Small Entity Statement(s) ☐ Statement filed in prior application  
Status still proper and desired

15. ☐ Certified Copy of Priority Document(s)  
(if foreign priority is claimed)

16. ☐ Other: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

17. If a CONTINUING APPLICATION, check appropriate box and supply the requisite information:

☐ Continuation ☒ Divisional ☐ Continuation-in-part (CIP) of prior application No. 08 / 841,564, filed April 30, 1997

## 18. CORRESPONDENCE ADDRESS

☒ Customer Number or Bar Code Label

05514

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NAME			
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CLAIMS	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
TOTAL CLAIMS (37 CFR 1.18(c))	1	-20 =	0	X \$ 18.00 =	\$000.00
INDEPENDENT CLAIMS (37 cfr 1.16(b))	1	-3 =	0	X \$ 78.00 =	\$000.00
MULTIPLE DEPENDENT CLAIMS (if applicable) (37 CFR 1.16(d))				\$260.00 =	\$000.00
				BASIC FEE (37 CFR 1.18(a))	\$690.00
Total of above Calculations =					\$690.00
Reduction by 50% for filing by small entity (Note 37 CFR 1.9, 1.27, 1.28).					
TOTAL =					\$690.00

## 19. Small entity status

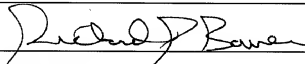
- a. ☐ A Small entity statement is enclosed
- b. ☐ A small entity statement was filed in the prior nonprovisional application and such status is still proper and desired.
- c. ☐ Is no longer claimed.

20. ☒ A check in the amount of \$ 690.00 to cover the filing fee is enclosed.21. ☐ A check in the amount of \$ \_\_\_\_\_ to cover the recordal fee is enclosed.

## 22. The Commissioner is hereby authorized to credit any overpayments or charge any deficiencies to Deposit Account No. 06-1205:

- a. ☒ Fees required under 37 CFR 1.16.
- b. ☐ Fees required under 37 CFR 1.17.
- c. ☐ Fees required under 37 CFR 1.18.

## SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

NAME	RICHARD P. BAUER, REG. NO. 31,588
SIGNATURE	
DATE	July 24, 2000



signal, a CDS/AGC circuit 3 for effecting sample holding of the image signal, thereby obtaining an appropriate signal level, a digital signal processing unit 4 for effecting A/D conversion on the image signal from the CDS/AGC circuit 3 and effecting digital signal processing, an NTSC encoder 5 for converting the digital image signal from the digital signal processing circuit 4 into an NTSC image signal, a cable 6 connecting the image pickup unit 10 and the image display unit 11, a monitor 7 for displaying the NTSC image signal supplied from the image pickup unit 10 or reproduced from a recording medium to be explained later, a recording/reproducing unit 8 for recording the NTSC image signal from the image pickup unit 10 on a recording medium or reproducing such signal from the recording medium, and attaching/detaching means 9a, 9b for mechanically attaching or detaching the image pickup unit 10 and the image display unit 11.

In such configuration, the image pickup operation by the image pickup unit 10 can be made while the image display unit 11 is separated, and both can be united in use, if necessary, by the attaching/detaching means 9a, 9b.

In such conventional camcorder, however, a cable is extended from the image pickup unit and hinders the freedom of image pickup operation.

# SUMMARY OF THE INVENTION

In consideration of the foregoing, an object of the present invention is to separate the image pickup unit and the image display unit in mutually separable and unitable manner, thereby increasing the freedom in the image pickup operation.

Another object of the present invention is to avoid increase of the electric power consumption in attaining the above-mentioned object.

Still another object of the present invention is to achieve efficient image transmission from the image pickup unit to the image display unit.

The above-mentioned objects can be attained, according to the present invention, by an image pickup device comprising image pickup means for pickup the image of an object and outputting image data, first compression encoding means for compression encoding of the image data, wireless transmission means for modulating thus compression encoded image data for transmission to a wireless transmission channel, and connection means adapted to be mechanically and electrically connected in detachable manner to a display device for displaying the image picked-up by the image pickup device and to transmit the above-mentioned image data from the image pickup means.

Also according to the present invention, there is provided a display device comprising wireless reception

means for receiving and demodulating the compression encoded and modulated image data from the wireless transmission channel, first expansion means for expanding thus demodulated image data thereby obtaining  
5 first image data, connection means adapted to be mechanically and electrically connected in detachable manner to the image taking device and to receive second image data from the image pickup device, signal processing means for selectively receiving the first  
10 and second image data and processing thus received image data to output an image signal of a predetermined system, and display means for displaying the image signal of the above-mentioned predetermined system.

Also according to the present invention, there is  
15 provided an image pickup system comprising an image pickup device including image taking means for taking the image of an object and outputting image data, compression encoding means for compression encoding of the image data, wireless transmission means for  
20 modulating thus compression encoded image data for transmission to wireless transmission channel, and first connection means adapted to be mechanically and electrically connected in detachable manner to a display device for displaying the image picked-up by  
25 the image pickup device and to transmit the above-mentioned image data from the image pickup means; and a display device including wireless reception means for

receiving and demodulating the transmitted image data from the wireless transmission channel, expansion means for expanding thus demodulated image data thereby obtaining first image data, second connection means adapted to be mechanically and electrically connected in detachable manner to the first connection means and to receive second image data from the image pickup device, signal processing means for selectively receiving the first and second image data and processing thus received image data to output an image signal of a predetermined system, and display means for displaying the image signal of the above-mentioned predetermined system.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a block diagram showing an image pickup unit in a first embodiment of the present invention;

Fig. 2 is a block diagram showing an image display unit in the first embodiment;

Fig. 3 is a block diagram showing an image taking unit in a second, third or fifth embodiment;

Fig. 4 is a block diagram showing an image display unit in the second embodiment;

Fig. 5 is a block diagram showing a JPEG image compression circuit;

Fig. 6 is a block diagram showing a JPEG image expansion circuit;

Fig. 7 is a block diagram showing a DV image compression circuit:

Fig. 8 is a block diagram showing an image display unit in the third embodiment;

5 Fig. 9 is a block diagram showing an image taking unit in a fourth embodiment;

Fig. 10 is a block diagram showing an image display unit in the fourth embodiment;

10 Fig. 11 is a block diagram of an MPEG image compression circuit;

Fig. 12 is a block diagram of an MPEG image expansion circuit;

Fig. 13 is a block diagram showing an image display unit in the fifth embodiment; and

15 Fig. 14 is a block diagram of a conventional camcorder.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

20 In the following there will be explained first to fifth embodiments in which the present invention is applied to a camcorder, with reference to the attached drawings. In Figs. 1 to 13, mutually corresponding components are represented by a same number and will not be explained repeatedly.

25 Fig. 1 is a block diagram of an image pickup unit 100 of a camcorder in a first embodiment of the present invention, and Fig. 2 is an image display unit 200 of



the camcorder.

In the image pickup unit 100 shown in Fig. 1, there are provided a lens 101 for forming the image of an object, an image pickup device 102 for converting thus formed image into an image signal, a CDS/AGC circuit 103 for effecting sample holding on the image signal thereby providing an appropriate signal level, a digital signal processing circuit 104 for A/D conversion of the image signal from the CDS/AGC circuit 103 and digital signal processing, an image compression circuit 105 for compression encoding of the digital image signal from the digital signal processing circuit 104, a spectrum diffusion transmission circuit 106 for transmitting the compressed image data from the image compression circuit 105 by spectrum diffusion modulation, and a transmitting antenna 107.

There are also provided a microcomputer 108, a power source 109, a power source control unit 110 for on/off control of the power supply to various units according to commands from the microcomputer 108, a joining detection device 112 for detecting that an image display unit 200 to be explained later is coupled, a signal connection device 113 for connecting the digital signal processing circuit 104 with the image display unit 200 when it is coupled, and an attaching/detaching device 114 including the joining detection device 112 and the signal connection device

113 and adapted to electrically and mechanically connect, in detachable manner, to the image display unit 200.

In the image display unit 200 shown in Fig. 2,  
5 there are provided a receiving antenna 201, a spectrum diffusion reception unit 202 for receiving the image data transmitted from the image pickup unit 100 and effecting demodulation to restore the compressed image data, an image expansion unit 203 for expanding the  
10 compressed image data to obtain the digital image signal, an NTSC encoder 204 for converting the digital image signal into the NTSC image signal, a recording/reproducing unit 205 for recording and reproducing the NTSC image signal, a recording medium  
15 206, and a monitor 207 for displaying the NTSC image signal.

There are also provided a microcomputer 208, a power source 209, a power source control unit 110 for on/off control of the power supply to various unit  
20 according to commands from the microcomputer 208, a joining detection device 211 for detecting that the image display unit 100 is coupled, a signal connection device 212 for connecting the NTSC encoder 204 with the image pickup unit 100 when it is coupled, and an  
25 attaching/detaching device 213 including the joining detection device 211 and the signal connection device 212 and adapted to electrically and mechanically

connect, in detachable manner, to the image pickup unit 100.

The image compression circuit 105 mentioned above can also be a pixel thinning-out circuit for processing the digital image signal from the digital signal processing circuit 104 in the unit of each pixel and reducing the number of pixels by pixel thinning-out. Also the image expansion circuit 203 mentioned above can also be a pixel interpolation circuit for processing the digital image signal from the spectrum diffusion reception unit 202 in the unit of each pixel to effect interpolation of the pixels.

In the above-explained configuration, when the image pickup unit 100 and the image display unit 200 are mutually separated, the image picked-up by the image pickup unit 100 is transmitted by wireless transmission to the image display unit 200 in a distant location and can be monitored and/or recorded and reproduced therein. Consequently the photographer can place the image pickup unit 100 in a distant location, without being concerned with the location of the image display unit 200, whereby freedom of the image pickup operation can be increased. It is also possible to take out the picked-up image from the signal connection device 113 and send it to an external equipment such as a computer. It is furthermore possible to supply the signal connecting device 212 of the image display unit

In such case, the joining detection devices 112,  
5 211 do not detect the coupled state, so that the  
microcomputers 108, 208 supply the power source control  
units 110, 210 with commands to feed electric power to  
all the units.

On the other hand, in case the image pickup unit 100 and the image display unit 200 are integrally coupled by connection through the attaching/detaching devices 114, 213, the joining detection devices 112, 211 detects such coupled state, whereby the microcomputers 108, 208 supply the power source control units 110, 210 with commands to terminal power supply to the spectrum diffusion transmission unit 106, the spectrum diffusion reception unit 202, the image compression circuit 105 and the image expansion circuit 203 whereupon the power supply to these circuits is terminated. In this manner the electric power consumption can be reduced in the coupled state.

In case the both units are mutually separated, the image signal is transmitted with a reduced data amount obtained by compression, so that it can be transmitted without difficulty even by wireless digital transmission which is limited in the transmission rate. Also the use of the spectrum diffusion modulation

allows transmission of the signal of a wide band with a limited electric power. On the other hand, in case the both units are mutually coupled, a high image quality can be obtained since the image signal is transmitted without compression.

In the following there will be explained a second embodiment.

The present embodiment employs, for the image compression, the JPEG compression method and the DV compression method. The JPEG compression method, capable of achieving a high compression rate for the image data, is suitable for image transmission in the wireless transmission channel limited in the transmission rate. The JPEG compression method is often employed in the personal computers as the image data format.

On the other hand, the DV compression method is widely employed in the digital CVR because of very high image quality, though the image data compression rate is not so high.

Fig. 3 shows the image pickup unit 100 in the second embodiment, and Fig. 4 shows the image display unit 200 therein.

In the image taking unit 100 shown in Fig. 3, there are provided a JPEG image compression circuit 115 for compressing, in the JPEG method, the digital image signal from the digital signal processing circuit 104,

a DV image compression circuit 116 for compressing, in the DV method, the digital image signal from the digital signal processing circuit 104, a compression method selecting switch 117 for connecting the digital signal processing circuit 104 to the JPEG image compression circuit 115 or the DV image compression circuit 116 according to a command from the microcomputer 108, and a compression method selecting switch 118 shifted in linkage with the switch 117, for connecting the signal connecting device 113 to the JPEG image compression circuit 115 or the DV image compression circuit 116.

In the image display unit 200 shown in Fig. 4, there are provided a JPEG image expansion circuit 214 for expanding the JPEG compressed image to restore the digital image signal, a DV image compression circuit 215 for compressing, by the DV method, the digital image signal from the JPEG image compression circuit 214, a DV image expansion circuit 216 for expanding the DV compressed image data from the signal connecting device 212 to restore the digital image signal, a digital recording/reproducing unit 217 for digital recording and reproduction of the DV compressed image data on or from the recording medium 206, and an image selecting switch 218 for connecting the digital recording/reproducing unit 217 to the DV image compression circuit 215 or the signal connecting device

In the above-explained configuration, when the image pickup unit 100 and the image display unit 20

In this state, the signal flows along paths of  
lens 101 → image pickup device 102 → CDS/AGC circuit  
103 → digital signal processing circuit 104 → switch  
117 → JPEG image compression circuit 115 → spectrum  
diffusion transmission unit 106 → transmitting antenna  
107 → receiving antenna 201 → spectrum diffusion  
reception unit 202 → JPEG image expansion circuit 214 →  
DV image compression circuit 215 → switch 218 → digital  
recording/reproducing unit 217 → recording medium 206,  
and of JPEG image expansion circuit 214 → NTSC encoder  
204 → monitor 207.

The JPEG compressed signal is released from the JPEG image compression circuit 115 through the switch 118 to the signal connecting device 113, it can be transmitted for example to the computer. Also the external DV compressed signal can be supplied to the image display unit 200 through the signal connecting device 212.

At the reproducing operation, the microcomputer 208 instructs the switch 218 to connect the digital recording/reproducing unit 217 to the DV image expansion circuit 216. In this state the signal flows along a path of recording medium 206 - digital recording/reproducing unit 217 - switch 218 - DV image expansion circuit 216 - NTSC encoder 204 - monitor 207.

On the other hand, when the image pickup unit 100 and the image display unit 200 are integrally coupled, the joining detection devices 112, 211 detect the coupled state. The microcomputer 108 of the image pickup unit 100 instructs the switch 117 to connect the digital signal processing circuit 104 to the DV image compression circuit 116. Linked with the switch 117, the switch 118 connects the signal connecting device 113 to the DV image compression circuit 116. On the other hand, the microcomputer 208 of the image display unit 200 instructs the switch image selecting switch 218 to connect the digital recording/reproducing unit 217 to the signal connecting device 212.



In this state, the signal flows along paths of lens 101 → image pickup device 102 → CDS/AGC circuit 103 → digital signal processing circuit 104 → switch 117 → DV image compression circuit 116 → switch 118 → signal connecting device 113 → signal connecting device 212 → switch 218 → digital recording/reproducing unit 217 → recording medium 206, and of signal connecting device 212 → DV image expansion circuit 216 → NTSC encoder 204 → monitor 207.

In the reproducing operation, the signal flows along a path of recording medium 206 → digital recording/reproducing unit 217 → switch 218 → DV image expansion circuit 216 → NTSC encoder 204 → monitor 207.

In the present embodiment explained above, when the image pickup unit 100 and the image display unit 200 are separated, the JPEG method is selected for image compression, whereby the wireless transmission can be achieved in efficient manner.

When the image taking unit 100 and the image display unit 200 are integrally coupled, the DV method is selected for image compression, thereby achieving digital image recording of high image quality.

Fig. 5 is a block diagram showing the configuration of the JPEG image compression circuit 115 in Fig. 3, wherein provided are a raster-block conversion unit 301, a DCT (discrete cosine transformation) unit 302, a quantization unit 303, a

Huffman encoding unit 304, a quantization table 305 to be used in the quantization unit 303, and a Huffman table 306 to be used in the Huffman encoding unit 304.

5 In the JPEG image compression circuit 115 of the above-explained configuration, the input digital image signal consisting of luminance/color difference signals of raster format is divided by the raster block conversion unit 301 into blocks of  $8 \times 8$  pixels, each represented by an  $8 \times 8$  square matrix. Then the DCT unit 10 302 executes a DCT process (discrete cosine transformation) on the  $8 \times 8$  matrix data. The transformed data, called DCT coefficients, are also  $8 \times 8$  matrix data of which terms at the upper left part represent the magnitudes of the low frequency 15 components of the original image while those at the lower right part represent the magnitudes of the high frequency components of the original image.

Then the quantization unit 303 executes divisions of the data in the above-mentioned matrix respectively, 20 utilizing a coefficient table called the quantization table 305. The quantization table 305 is weighted in the high frequency components with respect to the low frequency components, so that the results of the divisions constitute matrix data of which values 25 decrease progressively toward the higher frequency. Subsequently there is executed quantization to reduce the values less than a predetermined value to zero,

whereby most values in the lower right part of the matrix data become zero.

Then the above-mentioned matrix data are arranged as a data train in an order called zigzag scan, and are  
5 subjected to a transformation called Huffman encoding in the Huffman encoding unit 304. This transformation replaces a redundant portion of the data (a data portion where a same value appears in continuation). In the above-mentioned data train, the portion with  
10 value 0 in continuation is significantly shortened, whereby the amount of the image data is compressed.

Fig. 6 is a block diagram showing the configuration of the JPEG image expansion circuit 214 in Fig. 4, wherein provided a Huffman decoding unit  
15 401, a Huffman table 402 to be used in the Huffman decoding unit 401, an inverse quantization unit 403, a quantization table 404 for be used in the inverse quantization unit 403, an inverse DCT unit 405, and a block-raster conversion unit 406.

20 In the JPEG image expansion circuit 214 of the above-explained configuration, the input JPEG compressed image signal is subjected to Huffman decoding in the Huffman decoding unit 401 to provide the original data train. This data train is returned  
25 to the matrix data, which are subjected to multiplications in the inverse quantization unit 403 based on the quantization table 404. The matrix data

obtained in this state contain a larger number of 0 in the higher frequency components, in comparison with the aforementioned DCT coefficients. Then the inverse DCT unit 405 executes an inverse DCT and the block-raster conversion unit 406 rearranges the blocks in the original order, thereby providing the expanded digital image.

Fig. 7 shows the configuration of the DV image compression circuit 215 in Fig. 4, wherein provided a block division shuffling circuit 501, a DCT operation weighing circuit 502, a rearrangement circuit 503, an adaptive quantization circuit 504, a variable length encoding circuit 505, a deshuffling circuit 506, a motion detection circuit 507 and a code amount estimation circuit 508.

In the configuration explained above, the data with converted transmission rate are converted, in the block division shuffling circuit 501, into blocks of 8x8 pixels each, in each of the luminance signal and the two color difference signals, and a macroblock is constituted by six blocks consisting of four Y signal blocks and two color difference signal blocks. The divided data are then subjected to a rearrangement of the positions on the image in order to average the amount of information constituting the portion of a fixed length, and are subjected to the DCT operation (discrete cosine transformation) in the DCT operation

weighing circuit 502. In this operation, an image with a large amount of motion is processed within a frame, and the motion detection circuit 507 is provided for this purpose. After the DCT operation, the data are  
5 weighted, rearranged by the rearrangement circuit 503, and quantized by the adaptive quantization circuit 504. The quantized data are subjected to variable length coding (VLC) in the variable length encoding circuit 505, in such a manner that the amount of codes after  
10 variable length encoding becomes constant for every macroblock, by estimating the amount of codes at the quantization. The encoded data are outputted after being returned to the original position in the image. The output digital signal is given an error correction  
15 code, and deshuffled by the deshuffling circuit 506, whereby compressed data are outputted.

In the following there will be explained a third embodiment.

In this embodiment, the image pickup unit 100 is  
20 identical, in configuration, with that shown in Fig. 3 in the second embodiment, but the image display unit 200 has a configuration shown in Fig. 8, which is different in the arrangement of the various units from that shown in Fig. 4.

25 In the above-mentioned configuration, when the image pickup unit 100 and the image display unit 200 are mutually separated, the signal flows along paths of

lens 101 → image pickup device 102 → CDS/AGC circuit  
103 → digital signal processing circuit 104 → switch  
117 → JPEG image compression circuit 115 → spectrum  
diffusion transmission unit 106 → transmitting antenna  
5 107 → receiving antenna 201 → spectrum diffusion  
reception unit 202 → JPEG image expansion circuit 214 →  
DV image compression circuit 215 → switch 218 → digital  
recording/reproducing unit 217 → recording medium 206,  
and of switch 218 → DV image expansion circuit 216 →  
10 NTSC encoder 204 → monitor 207.

At the reproducing operation, the signal flows  
along a path of recording medium 206 → digital  
recording/reproducing unit 217 → DV image expansion  
circuit 216 → NTSC encoder 204 → monitor 207.

15 On the other hand, when the image pickup unit 100  
and the image display unit 200 are integrally coupled,  
the signal flows along paths of lens 101 → image pickup  
device 102 → CDS/AGC circuit 103 → digital signal  
processing circuit 104 → switch 117 → DV image  
20 compression circuit 116 → switch 118 → signal  
connecting device 113 → signal connecting device 212 →  
switch 218 → digital recording/reproducing unit 217 →  
recording medium 206, and of switch 218 → DV image  
expansion circuit 216 → NTSC encoder 204 → monitor 207.

25 At the reproducing operation, the signal flows  
along a path of recording medium 206 → digital  
recording/reproducing unit 217 → DV image expansion

circuit 216 → NTSC encoder 204 → monitor 207.

In the following there will be explained a fourth embodiment.

This embodiment employs MPEG compression method  
5 instead of the JPEG compression method in the second  
and third embodiments. Consequently the image pickup  
unit 100 is provided, as shown in Fig. 9, with an MPEG  
image compression circuit 119, and the image display  
unit 200 is provided, as shown in Fig. 10, with an MPEG  
10 image expansion circuit 219. The remaining parts in  
Fig. 9 correspond to those in Fig. 3, and the remaining  
parts in Fig. 10 correspond to those in Fig. 4. Also  
the signal paths in the recording and reproducing  
operations are similar to those in the configurations  
15 shown in Figs. 3 and 4.

Fig. 11 is a block diagram showing the  
configuration of the MPEG image compression circuit  
119, wherein provided are an information source encoder  
801 for compressing the amount of input information by  
20 effecting the aforementioned DCT, quantization etc., a  
video signal multiplexer 802 for converting thus  
compressed data into data based on the MPEG format, a  
transmission buffer 803 for transmitting the data of  
the above-mentioned format at a predetermined data  
25 rate, and an encoding controller 804 for increasing or  
decreasing the amount of the generated information.

Fig. 12 is a block diagram showing the

configuration of the MPEG image expansion circuit 219,  
wherein provided are a reception buffer 901 for  
securing a decoding process time for the received data,  
a video signal demultiplexer 902 for extracting the  
5 compressed data from the received format data, and an  
information source decoder 903 for restoring the  
original image signal by inverse quantization, inverse  
DCT etc.

The MPEG compression method is featured by  
10 executing, in the information source encoder 801, an  
anticipated encoding of representing the object image  
in the form of the difference from a past image or the  
difference from an anticipated image estimated from the  
past image, in addition to the aforementioned DCT and  
15 quantization, and can provide a higher compression  
rate, in comparison with the JPEG method which provides  
a series of compressed images each completed within an  
image frame.

In the following there will be explained a fifth  
20 embodiment.

This embodiment employs the MPEG compression  
method in the third embodiment shown in Fig. 8, instead  
of the JPEG compression method therein. Consequently  
the image display unit 200 is provided with an MPEG  
25 image expansion circuit 219 but is same in other parts  
as the configuration shown in Fig. 8. The image pickup  
unit 100 is same as that shown in Fig. 9. Also the



signal flow paths in the recording and reproducing operations are same as those in the third embodiment.

In the foregoing embodiments, when the image pickup device and the image display device are mutually separated, the image pickup device can send the compression encoded image data to the image display device by wireless transmission, without the connecting cable and with a reduced data amount, whereby the freedom of the image pickup operation can be increased.

Also when the image pickup device and the image display device are integrally coupled through the connection means, the image pickup device can directly transmit the image data through the connection means.

Also satisfactory image transmission can be achieved by selecting two suitable compression methods. In particular, the JPEG compression method enables efficient transmission when the image pickup device and the image display device are mutually separated, and the DV compression method allows to improve the image quality when the devices are integrally coupled.

Also the electric power consumption can be saved by interrupting the power supply to the unnecessary circuits, when the devices are integrally coupled.

It is also rendered possible, in the separated state of the devices, to send the image data to an external equipment from the connection means of the image pickup device, and to supply the connection means

of the image display device with external image data  
and to display such image data.

Many widely different embodiments of the present  
invention may be constructed without departing from the  
5 spirit and scope of the present invention. It should  
be understood that the present invention is not limited  
to the specific embodiments described in the  
specification, except as defined in the appended  
claims.

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1. An image pickup device comprising:  
image pickup means for pickup the image of an  
object and outputting image data;

wireless transmission means for modulating said compression encoded image data and transmitting said data to a wireless transmission channel; and

2. An image pickup device according to claim 1,  
wherein:

second compression encoding means for effecting  
compression encoding of said image data from said image  
pickup means by a second compression method;

detection means for detecting that said display device is connected to said connection means; and

selection means for selecting said second compression encoding means, upon detection of the connection of said display device, thereby providing said connection means with said second image data.

5

3. An image pickup device according to claim 2, wherein said selection means is adapted, when the connection of said display device is not detected, to provide said connection means with said first image data.

10

4. An image pickup device according to claim 2, wherein said first compression method is the JPEG compression method and said second compression method is the DV compression method.

15

5. An image pickup device according to claim 2, wherein said first compression method is the MPEG compression method and said second compression method is the DV compression method.

20

6. An image pickup device according to claim 1, further comprising control means adapted to detect that said display device is connected to said connection means, and, in response to said detection, to restrict the supply of power to said first compression encoding means and said wireless transmission means.

25

7. An image pickup device according to claim 1, wherein said wireless transmission means is adapted to effect spectrum diffusion modulation on said image data.

5

8. An image pickup device according to claim 1, wherein said first compression encoding means is adapted to compress the image data by a thinning-out process.

10

9. A display device comprising:

wireless reception means for receiving the compression encoded and modulated image data from a wireless transmission channel and demodulating said image data;

15

first expansion means for expanding said demodulated image data to obtain first image data;

connection means adapted to be electrically and mechanically connected, in a detachable manner, to an image pickup device and to receive second image data from said image pickup device;

20

signal processing means for selectively receiving said first or second image data and processing said received image data to output an image signal of a predetermined format; and

25

display means for displaying the image signal of said predetermined format.

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10. A display device according to claim 9,  
wherein said first image data are obtained by  
compression encoding with a first compression method,  
while said second image data are obtained by  
5 compression encoding with a second compression method,  
and said display device further comprising:

second expansion means for expanding said second  
image data and providing said signal processing means  
with said second image data selectively with said first  
10 image data.

11. A display device according to claim 9,  
further comprising recording and/or reproducing means  
for recording and/or reproducing the image signal  
15 obtained from said signal processing means on or from a  
recording medium.

12. A display device according to claim 10,  
further comprising:  
20 compression encoding means for effecting  
compression encoding of said first image data, obtained  
from said first expansion means, with said second  
compression method;

detection means for detecting that said image  
25 pickup device is connected to said connection means;

selection means for selecting said second image  
data from said connection means in case the connection

of said image pickup device is detected, or the image data from said compression encoding means in case said connection is not detected; and

5 recording and/or reproducing means for recording and/or reproducing said selected image data on and/or from a recording medium.

13. A display device according to claim 9,  
10 wherein said first image data are obtained by compression encoding with a first compression method, while said second image data are obtained by compression encoding with a second compression method, and said display device further comprising:

15 compression encoding means for effecting compression encoding of said first image data, obtained from said first expansion means, with said second compression method;

detection means for detecting that said image pickup device is connected to said connection means;  
20 selection means for selecting the image data from said connection means in case the connection of said image pickup device is detected, or the image data from said compression encoding means in case said connection is not detected; and

25 third expansion means for expanding said selected image data and providing said signal processing means with said expanded image data.

14. A display device according to claim 13,  
further comprising recording/reproducing means for  
recording or reproducing said selected image data on or  
from a recording medium.

5

15. A display device according to claim 9,  
further comprising control means adapted to detect that  
said image pickup device is connected to said  
connection means, and, in response to said detection,  
10 to terminate the supply of power to said wireless  
reception means and said expansion means.

16. A display device according to claim 10,  
further comprising control means adapted to detect that  
15 said image pickup device is connected to said  
connection means, and, in response to said detection,  
to terminate the supply of power to said wireless  
reception means and said expansion means.

20 17. A display device according to claim 10,  
wherein said first compression method is the JPEG  
compression method and said second compression method  
is the DV compression method.

25 18. A display device according to claim 13,  
wherein said first compression method is the JPEG  
compression method and said second compression method



19. A display device according to claim 10,  
wherein said first compression method is the MPEG

20. A display device according to claim 13,  
wherein said first compression method is the MPEG  
compression method and said second compression method  
is the DV compression method.

22. A display device according to claim 9,  
wherein said demodulated image data are image data  
compressed by thinning-out, and said first expansion  
means is adapted to expand said image data by  
interpolation.

23. A display device according to claim 9,  
25 wherein said signal processing means is adapted to  
output an image signal of NTSC system.

24. An image pickup system comprising an image pickup device including image pickup means for pickup the image of an object and outputting image data; compression encoding means for effecting compression encoding of said image data; wireless transmission means for modulating said compression encoded image data and transmitting said data to a wireless transmission channel; and first connection means adapted to be electrically and mechanically connected, in detachable manner, to a display device for displaying the image pickup by said image pickup means and to transmit said image data from said image pickup means; and a display device including wireless reception means for receiving said transmitted image data from said wireless transmission channel and demodulating said image data; expansion means for expanding said demodulated image data to obtain first image data; second connection means adapted to be electrically and mechanically connected, in a detachable manner, to said first connection means and to receive second image data from said image pickup device; signal processing means for selectively receiving said first or second image data and processing said received image data to output an image signal of a predetermined format; and display means for displaying the image signal of said predetermined format.

ABSTRACT OF THE DISCLOSURE

An image pickup system comprising an image pickup device including an image pickup element for pickup the image of an object and outputting image data, a  
5 compression encoding circuit for effecting compression encoding of the image data, a wireless transmission circuit for modulating the compression encoded image data and transmitting the data to a wireless transmission channel, and a first connector adapted to  
10 be electrically and mechanically connected, in detachable manner, to a display device for displaying the image picked-up by the image pickup element and to transmit the image data from the image pickup element; and a display device including a wireless reception  
15 circuit for receiving the transmitted image data from the wireless transmission channel and demodulating the image data, an expansion circuit for expanding the demodulated image data to obtain first image data, a second connector adapted to be electrically and  
20 mechanically connected, in a detachable manner, to the first connector and to receive second image data from the image pickup device, a signal processing circuit for selectively receiving the first or second image data and processing the received image data to output  
25 an image signal of a predetermined format, and a monitor for displaying the image signal of the predetermined format.

FIG. 1

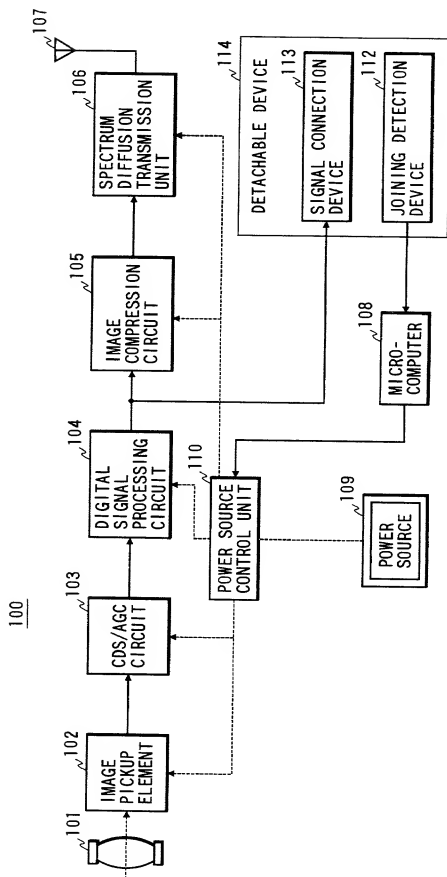


FIG. 2

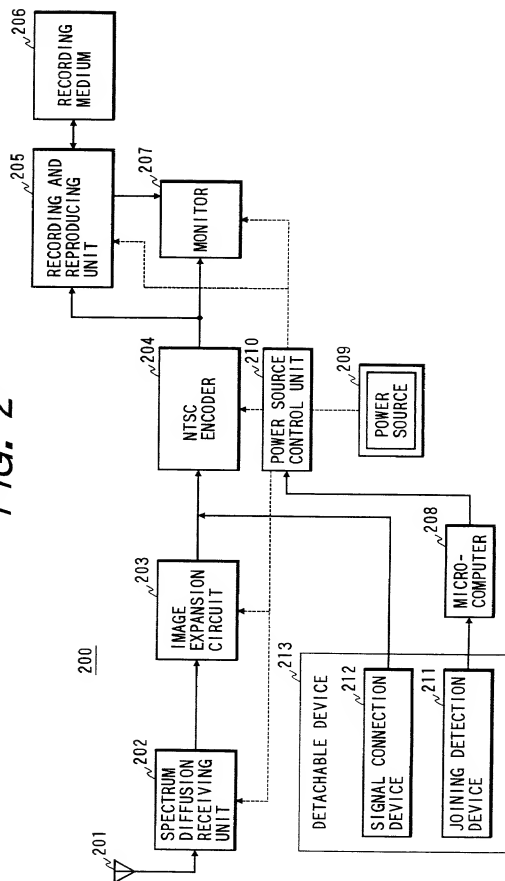
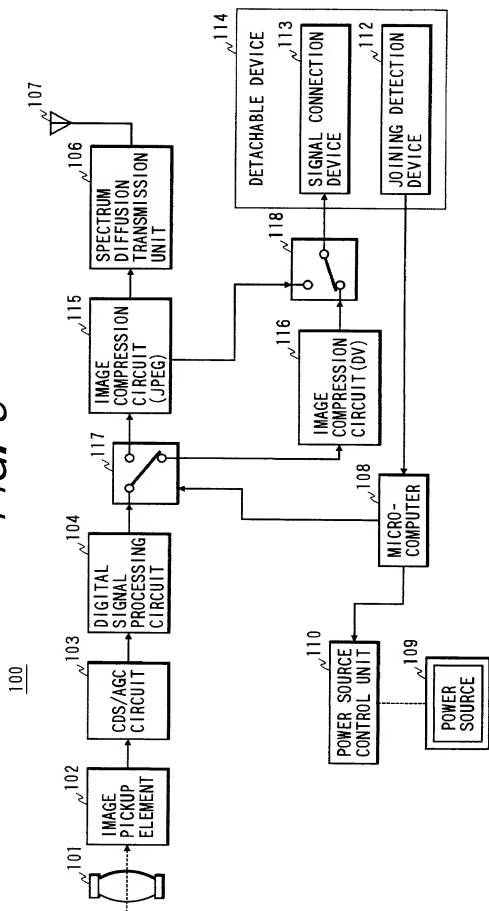


FIG. 3



**FIG. 4**

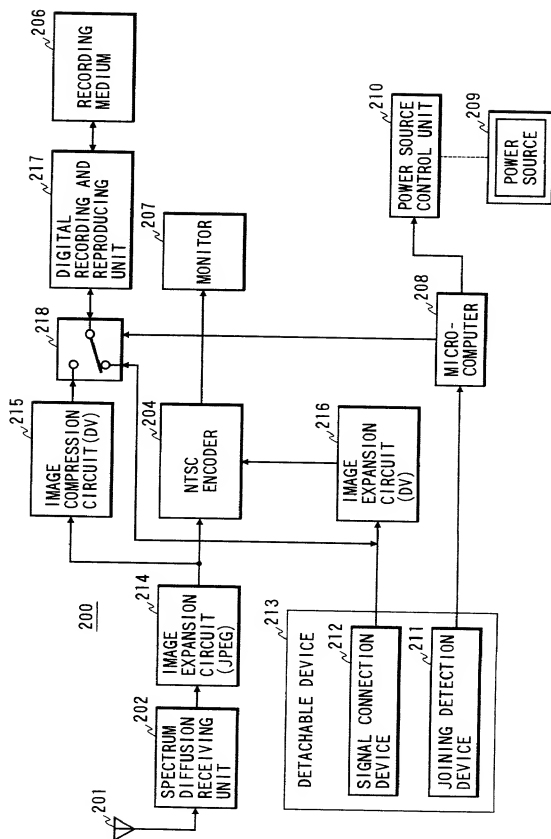


FIG. 5

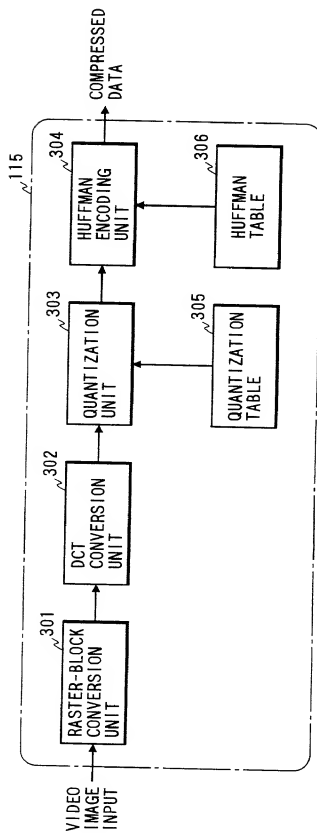




FIG. 6

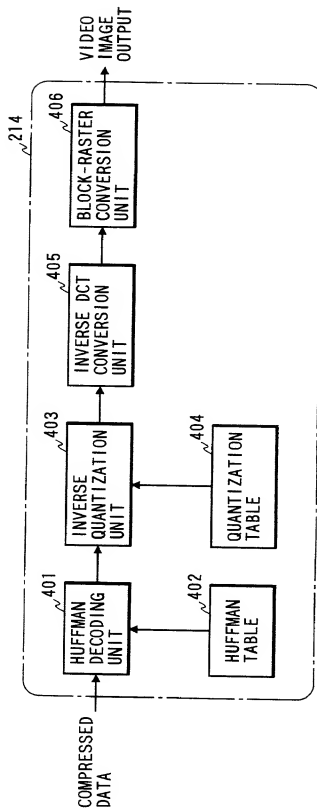


FIG. 7

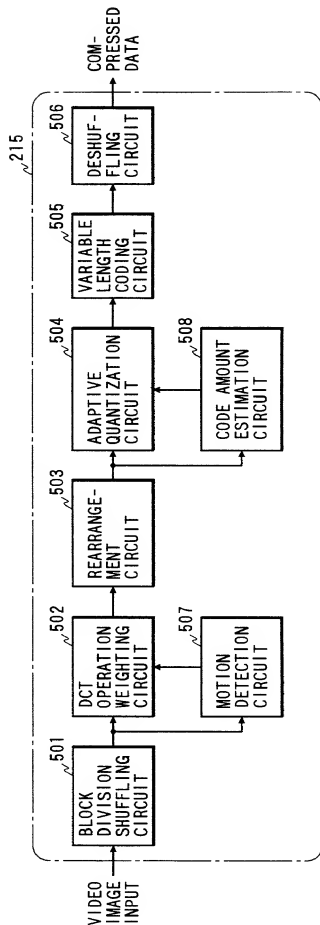


FIG. 8

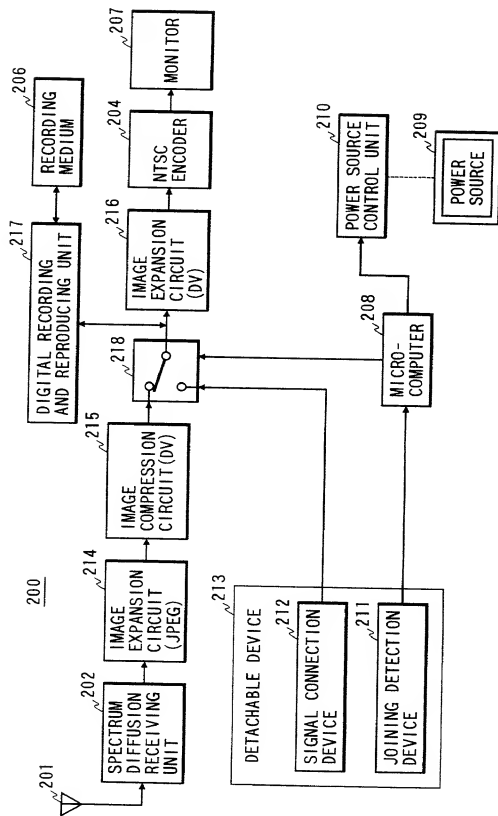


FIG. 9

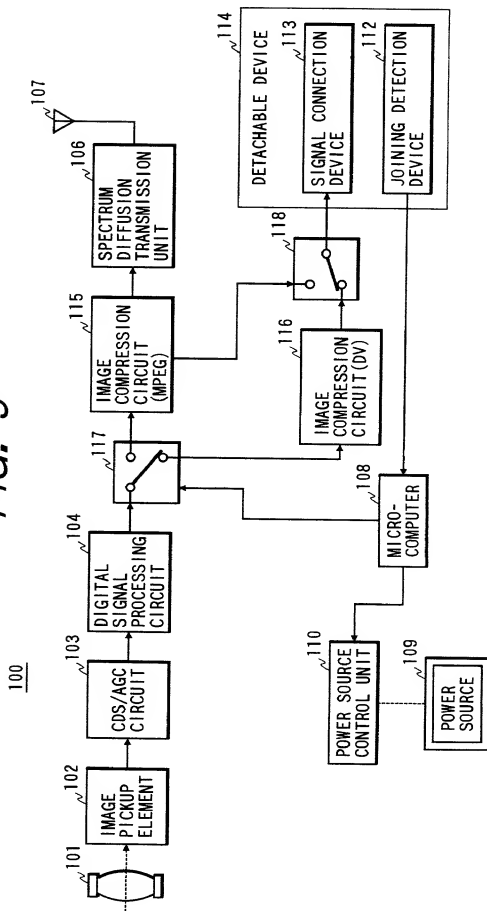


FIG. 10

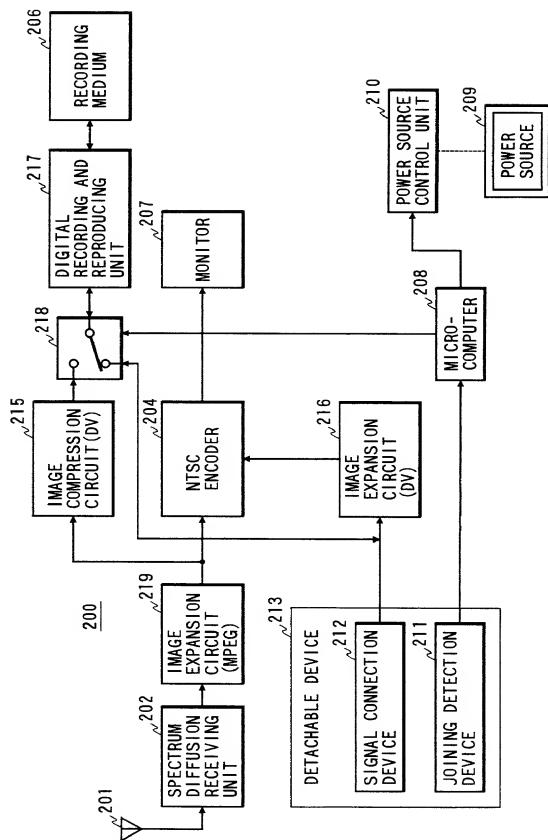


FIG. 11

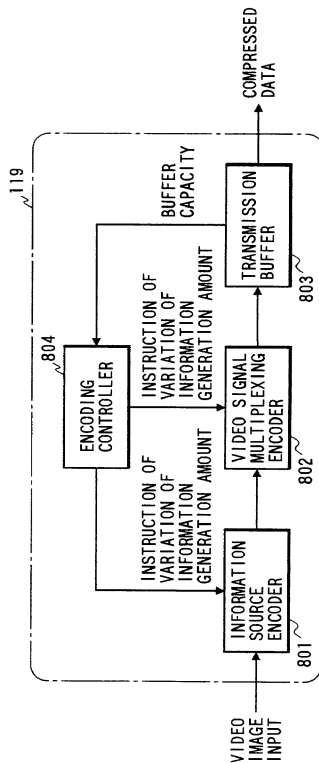


FIG. 12

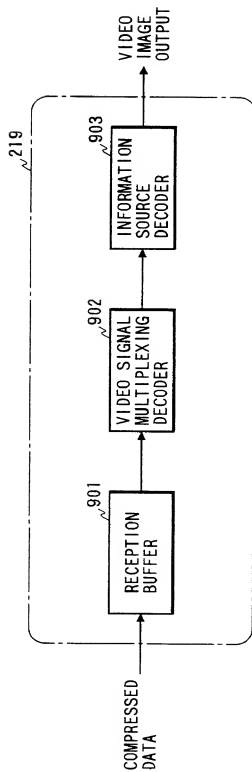


FIG. 13

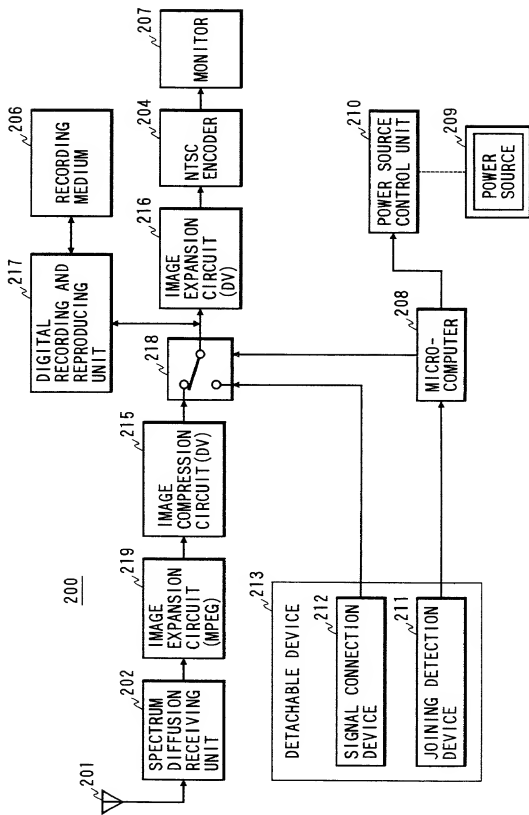
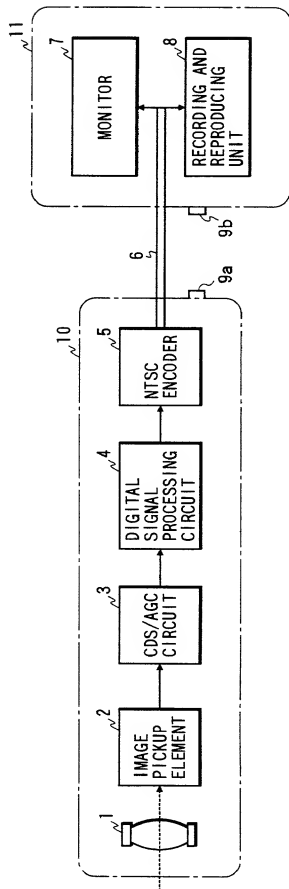




FIG. 14



**COMBINED DECLARATION AND POWER OF ATTORNEY  
FOR PATENT APPLICATION**

**COPY**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled IMAGE PICKUP SYSTEM WITH  
SEPARABLE/ATTACHABLE IMAGE PICKUP DEVICE AND DISPLAY DEVICE

\_\_\_\_\_, the specification of which  
☐ is attached hereto. ☒ was filed on April 30, 1997 as Application  
No. 08/841,564

and was amended \_\_\_\_\_ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate listed below and have also identified below any foreign application for patent or inventor's certificate having a filing date before that of the application on which priority is claimed:

Country	Application No.	Filed (Day/Mo./Yr.)	Priority Claimed (Yes/No)
JAPAN	8-116479	10 May 1996	Yes
JAPAN	9-062892	17 March 1997	Yes

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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